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ENERGY $AVER$

"For Business and Industry"

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WARM UP YOUR SAVINGS WITH AN ENERGY EFFICIENT WATER HEATER

The Facts ...

Heating large quantities of water can be expensive for many operations – apartments, arenas, dry cleaners, restaurants and hotels, to name only a few. By installing mid- to high-efficiency domestic water heating systems, building owners and operators can reduce the amount of energy dollars going up in smoke.

Water heater or boiler efficiencies are normally rated on the basis of their thermal efficiency. The following formula can be used to determine efficiency: 100 per cent minus per cent of flue gas losses minus per cent of radiation and convection losses minus percent of blowdown water and (sediment) losses. Figure 1 shows a natural gas fired system that is 73 per cent efficient with flue gas losses comprising 20 per cent of the total losses.

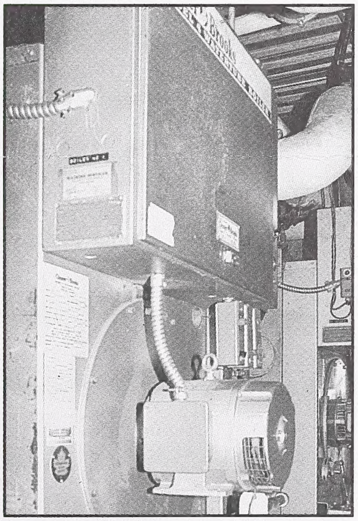
Flue gas temperature is a key indication of boiler efficiency. Lower flue gas temperatures result from greater efficiencies because less heat is lost out the stack. Higher ranges of efficiency can also be achieved by:

- Insulating tanks and pipes to reduce radiant and convective heat losses.
- Removing sediments from the tubes and tank.

Technology previously developed for mid-efficiency furnaces is now being applied to commercial hot water tanks. Today, gas-fired atmospheric water heaters are available in the 70 to 80 per cent thermal efficiency range.

To increase efficiency, manufacturers have incorporated some of the following features:

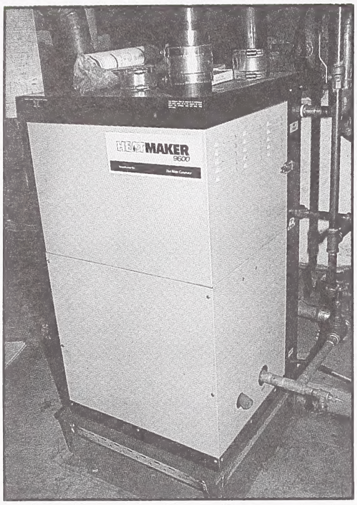
- motorized vent and/or flue dampers which can increase efficiency by reducing the amount of air convection through the exhaust (flue) vent.
- direct vent units (some power vented systems use outside air for combustion rather than warm inside air).
- powered gas burners in which a fan pressurizes a sealed combustion chamber and assists the removal of flue gases. A nozzle injects gas under pressure.
- multiple small flues instead of one large central flue to allow for more efficient heat exchange.
- low-mass heat exchangers.
- economizer coils.
- electronic spark or hot surface ignition.
- improved insulation.
- improved metallurgy.
- better burners and pilots.
- mechanisms to circulate the water and reduce sedimentation.



Prior to the Heat maker installation one of these 4,000,000 Btu boilers had to run continuously through the summer.

To achieve greater efficiency, look to direct vented units or powered gas burners that are currently available in the 90 to 95 per cent efficiency range. Some advantages of these systems include:

- greatly reduced standby losses.
- more heat value being extracted from the fuel through greater heat exchanger surface and more baffles in the flue.



This hot water generator simply tapped into the existing supply and return lines (lower right) to maintain temperature in an existing storage tank (upper right).

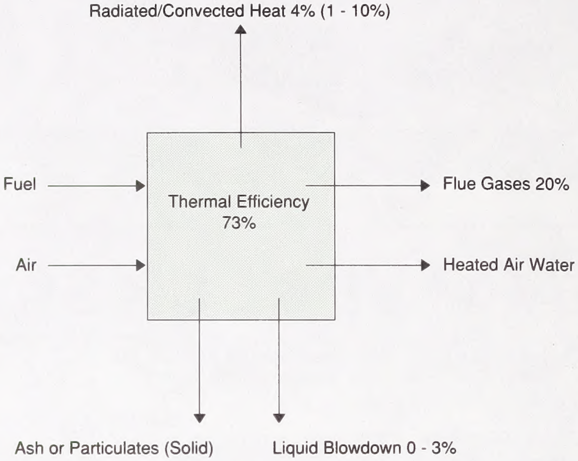
In Alberta, direct vent systems cost between 25 to 40 per cent more than atmospheric units. Because power gas appliances are more complicated to manufacture, their current price is more than double that of atmospheric units.

Some buildings have electric water heating systems. In Alberta, conversion to natural gas is generally a worthwhile consideration. Instantaneous or tankless water heating systems are also on the market but, as delivered water temperature is a function of flowrate, they seldom deliver the flow of water at the temperature desired for most commercial operations.

Many buildings use their main space heating boilers for heating hot water. Keeping these boilers running during the summer months just to heat domestic or process water consumes a lot of energy.

Heating domestic water need not be expensive. Advancements in water heating efficiency can help warm up your savings while cooling down your costs.

Figure 1: Hot Water Boiler Thermal Efficiency



The Application ....

Owned and operated by Westair Resources Ltd., the Executive Flight Centre in Calgary houses a main terminal and two large hangars which occupy 123,500 square feet (11,480 square metres) of floor area. The terminal and the larger hangar were built in 1979 while the smaller hangar was constructed 10 years earlier.

The centre also leases an additional hangar to tenants like the Alberta Energy Company. This hangar, built in 1982, covers 72,300 square feet of floor space (6720 square metres).

Several years ago, general manager, Jim Bogle, was given the job of finding ways for the centre to save on energy costs. That's when he arranged a visit from Alberta's Energy Bus.

In July 1991, the Energy Bus team conducted an energy audit of the centre to assess the energy use and to identify areas of potential savings.

Prior to the audit, the centre was using a four-million BTU (British thermal unit) boiler to heat its hot

The Executive Flight Centre provides rebuilding, maintenance and other support services for military, corporate and private clients.

water year round. The boiler was one of two large boilers used during winter months to heat the facilities.

Water heated to about 180 degrees Fahrenheit (82 degrees Celsius) in the boiler was fed through a heat exchanger. Water for domestic and restaurant use was then passed though the same heat exchanger, raising its temperature to about 145 degrees F (63 degrees C) before being returned to a large storage tank.

In August 1991, a high-efficiency (96 per cent) hot water generator was installed to heat the water during the remainder of the summer.

Due to unseasonably cool weather, the new water heater operated for less than a month before the heating boiler had to be reactivated. During this period about $200 (86 gigajoules) in natural gas savings were achieved.

In 1992, the centre shut their large boiler off in late May and operated the energy efficient heatmaker until late August. During this time they saved $1390 (596 gigajoules) on their natural gas bill. Total gas savings since installation added up to $1590.

Electrical savings were also achieved by shutting down the combustion air supply fans for the main boiler, the main heating pump and the boiler water recirculation pump. In doing so, the centre saved $608 on their annual electrical bill.

Installation of the hot water generator cost about $4000 (material and labour). The Executive Flight Centre calculated the payback period on their investment in the hot water generator as follows: capital costs divided by net savings; $4000/$2198 = 1.81 years.

The Bottom Line

Calculating the potential savings and payback period from investing in a mid- to high-efficiency water heater (boiler) is not difficult. All you need to know is the amount of hot water used daily in your facility, the cost of natural gas and the thermal efficiency of your existing system.

Contact a plumbing and heating firm and ask them to provide you with a measurement of the flue gas efficiency of your present water heating equipment.

Then, use the the accompanying graph (figure 2) and calculations to determine your potential savings from installing a more efficient system.

First, locate your daily water use along the horizontal axis and read up to the line that represents the thermal efficiency of your system. Next, read across to the left to determine the number of BTU's your equipment burns each day.

To find the number of BTUs consumed by higher-efficiency units, repeat the technique by reading up to the appropriate efficiency line. You can determine the energy savings by subtracting the BTUs burned by a more efficient unit from the the BTUs consumed by your existing equipment.

To calculate the amount of money you can potentially save, use the following example:

Example: **Based on a small commercial hot water heater with 1000 feet of 1/2 inch insulated copper circulation pipe.**

Daily hot water use	500 gallons
Typical end use temperature	140°F
Typical makeup water temperature	50°F
Thermal efficiency of existing system	65 per cent
Thermal efficiency of proposed system	95 per cent
Cost of natural gas	$2.25/gigajoule
Daily BTU's of existing system	1.45 million
Daily BTU's of proposed system	1.0 million
BTU's saved	.45 million

$$\text{Dollars saved} = \frac{\text{BTU's saved x 365 days x cost/gigajoule}}{\text{947,950 BTU's/gigajoule}}$$

$$= \frac{\text{.45 million BTU's x 365 x \$2.25}}{947{,}950}$$

$$= \$389$$

Assuming an installed cost of about $2000 the system payback can be calculated as

$$\text{Payback} = \frac{\text{Installed Capital Cost}}{\text{Energy Savings}}$$

$$= \frac{\$2000}{\$389}$$

$$= 5.1 \text{ years}$$

Figure 2: Water Heating Efficiency

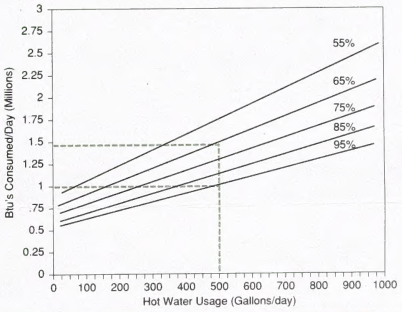
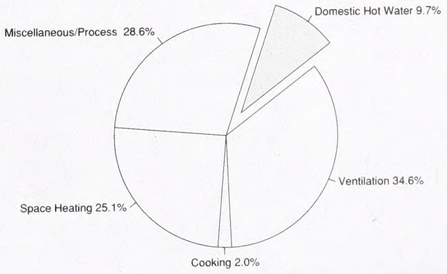


Figure 3: Natural Gas Usage
Based on 350 Audits since June 1988



SECTOR REVIEW

Having conducted energy audits of more than 1600 facilities throughout the province, Alberta's Energy Bus program has determined that energy use varies widely, depending on the type of building being audited and the activities in the building.

Following an audit, staff of the Energy Bus program suggest ways in which savings can be achieved through energy efficiency measures. On average, potential natural gas savings of about 24 per cent and potential electrical savings of about 16 per cent have been identified. Energy efficiency measures to save on water heating have been recommended during audits of close to 300 facilities.

Figure 3 shows an analysis of the natural gas use in 350 buildings audited after June 1988. Water heating represents 9.7 per cent of the total energy use of natural gas.

As indicated in Figure 4, electrical energy use for water systems is much less significant, representing one half of one per cent of the total use of electricity.

Figure 5 provides a comparison of various commercial sectors in terms of combustion efficiency savings as a percentage of total potential savings identified in the energy audits.

Figure 4: Electricity Usage
Based on 350 Audits since June 1988

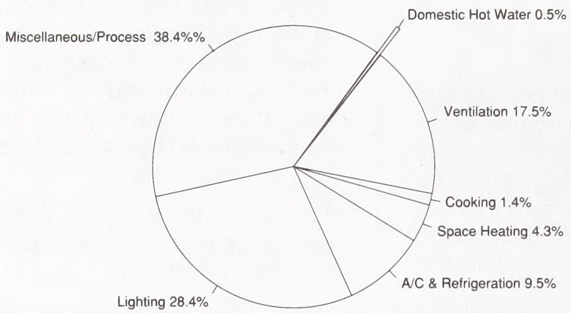
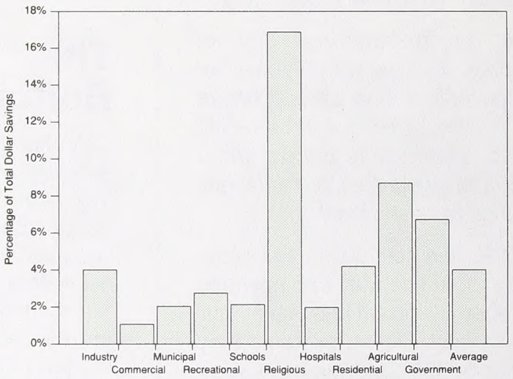
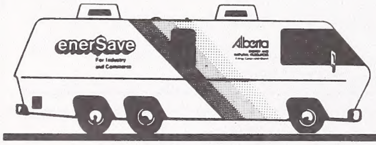


Figure 5: Combustion Efficiency Savings



FOR MORE INFORMATION

The article *Warm Up Your Savings With An Energy Efficient Water Heater* was researched and written by Shaun Martin and Carol Miyagawa. The Energy Efficiency Branch gratefully acknowledges editorial reviews done by Jim Bogle and Tom Watkins, Executive Flight Centre; Ken MacDonald, Crane Supplies (Wholesale); David Prevost, Emco Supply (Wholesale); and John Blake, Advantage Industries Inc.



ENERGY $AVER$

Energy $aver$ is a series of fact sheets about energy efficiency measures that have wide application in Alberta. Each issue highlights a different technology and its successful use in the province. The Sector Review summarizes energy use patterns of different facilities that have used Alberta's Energy Bus audit service. Comments, questions and suggestions are welcome.

Write or phone (collect) to be placed on the mailing list. You may also receive back issues or arrange for an Energy Bus audit (conducted at no charge).

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